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EDITORIAL NOTES

THE MANCHESTER STRIKE

HAPPILY the strike at two of the works of the Manchester Corporation Gas Department was comparatively short-lived. Even so, the general feeling in the Gas Industry will be that this small but important section of its workers have let the side down very badly. Manchester is not primarily a holiday resort, which means that it has war work to do. War work requires gas in the factory, and war workers require gas in their homes. Quite apart from this very serious aspect of the matter, throughout its history the Gas Industry has been conspicuously free from labour troubles of any magnitude. Except for a few teething troubles in the early days of the national joint negotiating machinery, there has not been for nearly a quarter of a century a stoppage as serious as the present strike at Manchester. It was in 1919 that the National Joint Industrial Council for the Gas Industry was formed, and during the whole of that time it has functioned satisfactorily. The employers' representatives are drawn from the Federation of Gas Employers, formed in the same year to secure mutual support and co-operation in dealing with all matters of common interest, and the employees' interests are looked after by representatives of their three trade unions. There have inevitably been differences from time to time, but so amicably have they been settled that the Council has been recognized as one of the most successful of the Joint Industrial Councils in the country.

Under the National Council there are a number of Regional Joint Industrial Councils, one of which covers the Manchester area and embraces about 80 gas undertakings. A tribute to the contribution which the Trade Union representatives on both National and Regional Joint Industrial Councils have made to the general harmony of the Industry was paid in the report on the Planning of the Gas Industry a few months ago. "They have not," said the Report, "confined their activities to wages and conditions of employment, but have shown an ever-increasing interest in the development of the Gas Industry and its services to the public."

Since the outbreak of the war the Council has entered into seven agreements, including the latest one, for wartime increases of wages, representing a total increase of 23s. 4d. per 47-hour week for day workers, and 3s. 11½d. per 8-hour shift for shift workers, with an additional 8d. per shift for shift workers engaged in connexion with gas production. The last increase prior to the one which formed the basis of the Manchester strike was agreed to in July of last year, the increase being dated back to the first pay-day in April, 1943. There was some agitation at Manchester early this year for further increases, and strike action was threatened, but the strike notices were withdrawn on the understanding that a national application would be put forward. The application was made, and was considered without delay. After consultation with the districts, the agreement was reached on April 13 under which the rates of gas workers were raised by 1d. per hour, with an additional 1d. per hour to shift workers engaged on gas production. Except at Manchester and in one or two neighbouring undertakings the agreement was well received. The workers at the two Manchester works affected declared that they were not prepared to accept the increase, and decided unofficially to cease work.

Wages in the Industry vary in different parts of the country according to the size of undertaking and the type of area, but taken as a whole they compare favourably with other public utilities. While even in peacetime, with the negotiating machinery which is available in most industries, use of the strike weapon appears to the onlooker almost invariably unjustified, there is a growing volume of indignation at the stoppages in vital war industries which have taken place in recent months. There is ample evidence of this salutary fact in the backing which the Government has received for its new preventive measures from almost every section of the community and shade of political opinion.

RESEARCH

THE past ten days have been veritably packed with talk about research; never before, we think, has so much attention been paid to the subject in this country in Parliament, among professional bodies, and in individual speeches which have been accorded a notable national press. The limelight has been directed on the research worker, in the desire, it would seem, to transform in a trice a hitherto small and rather humdrum community of scientific investigators into a vast army of magicians playing a star part at star fees. This interest is welcome enough and is a healthy sign pointing to a better future, and we hope that achievement will follow promise, that dreams will become realities. Dreams certainly abound, and science is destined to penetrate deeper and deeper into our lives. In the House last week there was talk of television—three-dimensional television in colour—in every home. Newpapers, it was suggested, would speedily become obsolete once the war was finished with. Thought would be transported through the air. It would, through research, be possible to detach the mind from the body, to leave the body at the seaside and to transact business by thought through the ether. There may be complications. There may be the chance of the soul getting back into the wrong body. But this by the way.

After last Wednesday's debate in the House, the research worker must have gone to bed a far, far happier man. A bold Government policy was called for; substantial financial aid was assured. The Lord President of the Council gave this assurance, adding most understandably, for the taxpayer will, of course, foot the bill, that Government support must be backed by public opinion, and the nation must become more aware of the importance of science. As a natural corollary, industry must be ready to take advantage of the new openings which the application of scientific research afforded. We take a few points from the debate which brought forth this assurance. It was urged that an expenditure of anything up to an additional £15,000,000 on research would be an investment for the country's future and would bring in a fine dividend. Reference was made to the recent report on coal research of the Parliamentary and Scientific Committee, in which it was stated that in 1913 only 15% of the potential energy of coal was being utilized, that by 1938 it had risen to 30%, that in the next 15 years it could be raised to 45%, and that this would add the small matter of £200,000,000 to the finances of the State, which sum would more than pay for the several thousands of extra research workers needed, who should be better paid. The view was expressed that the future very largely depended on the building up of an integrated industry based on coal, oil, power, and chemicals, and that the drive and direction should come from the Government. In truth we are roused to the basic need for research. We expect to enter an era in which the pursuit of science will receive recognition as never before. We expect greater regimentation of research. We sincerely hope that there will remain a field of free enquiry, for history has proved that free enquiry is one of the surest ways to a harvest of practical usefulness. We sincerely hope, too, that the general public, the taxpayer, will not be misled by over-enthusiastic propaganda about the results of wholesale research, will not have his hopes raised only to be followed by impatience and disillusionment. For the research worker cannot be fed to a research machine on the basis of so many pounds of sausage meat. The problem is not quite so simple as that. And we hope that the research worker will not come to believe that the future will continuously present an easy wicket.

COAL AND CHEMICAL INDUSTRY

FROM national debate we turn to the particular, and would refer to the Arthur Reavell Lecture given by Mr. J. G. Bennett, Director of B.C.U.R.A., to the Institution of Chemical Engineers on April 14. The title of the lecture was the same as the heading of this note, and we think that much of its substance was in the nature of a magic wand picture. Not that we decry imagination or deny its value; our point is merely that research hopes should have some relation to known possibilities. The thesis of the Lecture was twofold: that existing methods of coal processing hold out less promise than is supposed; that the prospects of a bold policy of research are " so encouraging as to justify a concerted attack on an ambitious scale." Mr. Bennett pointed out in the first place the all-important part that carbon plays in human life. He divided carbon into "static" and "dynamic" forms—the "dynamic," representing less than 1 part in 5,000 of accessible carbon, comprising all forms which can enter into exothermic reactions with oxygen. Coal is by far the largest store of "dynamic" carbon available to man. The whole 2,300 millions of the world's population do not take in as much energy directly in the form of food as is consumed in the form of coal by that fraction of the human race which constitutes the industrial population. In brief, coal is very important indeed. Could we utilize its energy in a better way than we use it at present? Does not research on coal cry out for vast support and encouragement? This, to our mind, epitomizes the theme of the Lecture; and as we listened to it we could not help thinking of the lines of Ben Jonson beginning "It is not growing like a tree in bulk . . ."

What about carbonization? Rightly or wrongly we gained the impression that Mr. Bennett hardly regards such "violent treatment" of coal (his own expression) as being significant. Although, he said, some 200 different pure compounds have been isolated from coal tar, only a few of these are of commercial importance. Present-day chemical industry, he argued, is turning more and more to the unsaturated bodies, and a great change must come over coal treatment if it is to meet this demand. "In the future, carbonization will be only one out of many processes for deriving from coal all kinds of carbon compounds, especially those of low molecular weight which are used for synthesis reactions." We come to the *status quo* in thought: "Coal has so long been used almost exclusively as a fuel that it scarcely seems to have occurred to people that it might be used without being burned, or, at any rate, *broken down by heat*." The italics are ours.

We appear to be living in an age of "destructive distillation" as distinct from constructive carbonization. And one aim of applied research on the big scale? We quote from the Lecture: "It is well known that coal has remarkable plastic properties, and this makes it the more surprising that research has not been very seriously directed in the past to the utilization of these properties in a process for making moulded articles direct from coal." Which led to contemplation of plastics production, and the comment that it takes about 1,000 lb. of phenol to make a ton of bakelite, which means that 3,000 tons of coal have to be carbonized in order to make one ton of product. But, to sit down properly, so to speak, on this carbonization business, "to replace 5% of the steel and 10% of the timber used in Great Britain by synthetic phenolic resins derived from coal would involve the impossible task of carbonizing 5,000 million tons of coal a year, or nearly four times the total world production." We seem to be quoting a good deal from the first Reavell Lecture. Unabashed we proceed to quote a little more. "Although upwards of 200 different compounds [*vide infra*] have been identified in coal tar, the great majority of these are either present in such small quantities or have so low a commercial value that they play no significant part in chemical industry." Copy-writers for Gas Industry publicity will no doubt take heed of this—and this: "If coal is to be regarded as a raw material from which high-value chemical products are to be derived, it must certainly be admitted that the process of coal carbonization is extremely crude." Compared with petroleum refining, carbonization, we learned, is a "primitive" process.

Presumably carbonization has some chemical value, however small as assessed by Mr. Bennett. So we turn to the use of coal for electricity generation, to find in the Lecture that, starting from coal, the production and use of electricity is a "terribly wasteful" form of energy conversion which sacrifices 80% of the thermal value of coal and involves the loss of any chemical value. "Even the meagre yield of valuable chemicals obtainable by carbonization is sacrificed when coal is burned in a present-day power station." So what? There remains the question of coal research itself, said Mr. Bennett, rounding-off his lecture thus: "The field is almost unbelievably wide, the harvest unlimited, and the number of workers still insufficient. It is to be hoped that the coal industry and the chemical industry will join hands in planning research into the production of chemicals from coal." And we ourselves hope that in the meantime the Gas Industry, aided by its modest Research Board, will evolve to still greater efficiency in what is fundamentally an efficient energy conversion process. We refer to carbonization.

PROMISE AND REALIZATION

WE have spoken about the raising of hopes and the chances of disillusionment; we have suggested that the research worker in the norm is neither a magician nor fit fodder for the sausage machine. We have in fact during the past few days read and listened to so much about research that we find it somewhat difficult to know when to stop thinking about it and writing about it. In fairness to our readers we will call a halt soon, but before doing so we should like to refer to just two more points which have impressed us about the matter in a broad way. The Institute of Fuel has arranged, most appropriately and opportunely, a series of meetings to discuss the organization of research. The first meeting of the series was held on Thursday last, when an Address full of interest by Dr. A. Parker, Director of Fuel Research, was followed by a discussion also full of interest, in which the Director of the Gas Research Board and the Director of B.C.U.R.A. joined. We intend to deal subsequently in the "JOURNAL" with the meeting as a whole, but here and now we should like to endorse the comments of Dr. Hollings concerning the motive and objective of research. The most obvious, he remarked, was the establishment of some new process or the manufacture of some new product, and whether it was a new process or a new product it was of the utmost importance that those who were engaged upon the work should be quite clear whether there was a reasonable prospect for the economics of the process as soon as it could be established, or whether the investigation was still at a stage at which the possibilities were being investigated without any reference to economics. Which strikes us as a much needed common-sense comment.

The other point is more abstract. It was made in a speech by Sir Edward Appleton in Manchester last Thursday, and was in effect a plea for the breaking down of the distinction between what is called pure and what is called applied research. To some extremists, he said, applied research no longer deserved the name of science, and was regarded as a distinctly lower form of occupation than any scientific inquiry of less immediate utility. On the other hand, there were those who claimed that science was merely a social servant and that it should be pursued only for practical ends. For them the balance of scientific work must be drawn in terms of social utility. The truth was that science was a single field, and an advance in one section of it very often had the most profound repercussion on the rest of it. There were scientific workers to whom discoveries were ends in themselves; there were others who created new knowledge or utilized existing knowledge for practical purposes. Using the same scientific method, they all belonged to the same family, and their efforts were not antagonistic but supplementary. Nor was it profitable to attempt to decide, as people had tried to do, which was the more important, a great discovery in pure science or a great discovery in applied science; whether, for example, Einstein's formulation of the theory of relativity or the discovery of penicillin was the more important to mankind. Einstein's

theory, like other great generalizations of the past, was epoch-making because of its unifying sweep and its wide theoretical implications. Once established, it remained as a rung in the ladder of progress from which higher steps were possible. Yet on the other hand penicillin was already saving valuable lives and would save countless more, including, perhaps, some of those very scientists whose work would be based on that of Einstein's. So who could judge?

Personal

Mr. THOMAS F. HASTINGS, Manager of the Cookstown Gas Company, has been appointed Manager of Omagh Municipal Gas-Works.

* * *

Councillor C. FORD, Manager of the Finedon Gas Company, has been elected Chairman of the Wellingborough Urban District Council.

* * *

Mr. R. O. ROBERTS, F.C.S., Engineer and Manager of the Gas and Water Department of the Skelmersdale U.D.C., Lancs, has been appointed Engineer and Manager to the Filey Gas Undertaking. Before his appointment at Skelmersdale, Mr. Roberts was Assistant Engineer with the Pudsey Gas Company, and prior to that was Chief Technical Assistant and Chemist to the Rhyl Gas Undertaking.

* * *

Following the death of Mr. F. Fielden, former Manager of the Gowerton Gas Company, the Directors have appointed Mr. A. PICKARD Engineer and Manager to the Company in addition to the position already held of Engineer, Manager, and Secretary to the Llanelly Gaslight Company. Mr. I. J. FERRIS remains as Secretary stationed at Gowerton, but general management control and purchasing will operate from the offices of the Llanelly Gaslight Company, Murray Street, Llanelly.

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A happy ceremony was held at the New Wortley Works of the Leeds Gas Department on April 17, when Mr. Newham, the Works Manager, in the presence of his colleagues, presented Mr. Arthur P. JENNINGS, Assistant Works Manager, with a cheque as a token of good wishes on his appointment as Deputy Gas Engineer to the Plymouth Corporation Gas Department. Mr. Jennings served his Articles under Mr. Shapley, Engineer and General Manager of the Leeds Corporation Gas Department, and has held various posts in the Department. He was made Assistant Works Manager at the New Wortley Works at the age of 24. He is a lieutenant in the T.A.R.O. doing service with the Army Cadet Force, and also a member of the Undertaking's Home Guard Unit.

Obituary

The death has occurred of Mr. ARTHUR ERNEST PHILLIPS, elder son of the late Mr. A. F. Phillips, formerly a Director, General Manager, Secretary, and Engineer of the St. Albans (Herts) Gas and Water Companies. For a good many years Mr. Ernest Phillips was in partnership with his father in Mr. Phillips's Westminster practice as a Consulting Engineer. During that period he was associated with the St. Albans Gas and Water Companies, and visited, in an advisory capacity, various gas and water undertakings in France, Italy, and Germany, and also the Colombo Gas and Water Company.

Primitiva Gas Company

Information reached London last week that the Argentine Government had issued an expropriation decree taking over the Primitiva Gas Company of Buenos Aires for £230,000, with a declaration that if the Company refused the money offered for its property an order for its seizure would be obtained from the Federal Judge. The issued capital amounts to nearly £3,000,000, most of which is held by Primitiva Holdings, Ltd., in which British investors are principally interested.

The only official statement issued in London as we go to press is that the Directors have not received any advices from their local representatives regarding the decree. The statement adds: "Pending the receipt of details, the Board are unwilling to believe that the Argentine Government intends to acquire the Company's assets for under 4,000,000 pesos (about £245,000), and are confident that proper treatment will be accorded to the Company under the Argentine constitution and the Argentine expropriation law. In the meantime they are taking all necessary steps to safeguard the interests of the shareholders."

Messages from Buenos Aires state that the price offered represented the difference between the value of the Company's property and the cost of removing the installations. The expropriation law empowers the authorities to take possession by placing at the disposal of the owners a judicial deposit of the price offered and rejected. Once this is effected the parties are subject to the decision of the law courts, and from the resolution of the judge or Supreme Court there are the usual recourses permitted by the law of procedure.

Victor Blagden & Co., Ltd., have changed their address to Friars House, New Broad Street, E.C. 2.

Manchester Gas Strike

[From our Correspondent]

Dissatisfaction with the award of the Joint Industrial Council for the Gas Industry on an application by the National Union of General and Municipal Workers for a national wages increase led to a strike on Wednesday, April 19, by about 500 men employed in the Manchester Corporation Gas-Works at Bradford Road and Rochdale Road, Manchester; the Partington Works, where about 200 men are employed, was not involved.

The application was for an all-round increase of 3d. per hour, and the award gave 1d. per hour to day workers and 2d. per hour to shift workers. It was accepted by the Union and no trouble has arisen in other areas, but it has been stated that the men asked for an increase of 6d. per hour and were dissatisfied with the Union because application was made for 3d. only. They acted against the advice given by the Union and the strike was therefore unofficial.

The day workers, chiefly labourers, who are the majority of the workers concerned, are on a rate of 1s. 8½d. per hour, and wartime increases total 23s. 4d. per week. The shift workers' rate ranges from 15s. 2½d. to 16s. 6½d. per shift; wartime increases amount to 4s. 7½d. per shift. Double time is paid for Sunday. Seven shifts per week have been worked during the last two or three years and the day workers have been on overtime. It has been estimated that 220,000 consumers have had their supply of gas cut off.

It had been arranged to hold a meeting of the North-West Regional Joint Council for the Gas Industry on Friday to discuss the men's grievances, but this was cancelled when the strike began. On April 19 there was a six-hours' conference between representatives of the men and the Union and officials of the Gas Department, but no agreement was reached, and at 6 a.m. on Thursday morning the morning shift did not turn in. The men were informed the door was open for further negotiations and their representatives could attend a special meeting of the Regional Council, when their case would be put forward by Councillor H. Butters, the District Organizer of the Union. If the offer was not accepted there would be no further negotiations until the men resumed work. A mass meeting rejected the offer and decided to continue the stoppage.

On Thursday afternoon Mr. J. H. Cadman, Commercial Manager and Secretary of the Gas Department, issued a statement that owing to the unofficial strike of gasworkers the manufacture of gas had ceased at the works concerned, and consumers were asked to see that all gas taps on equipment and meters were securely turned off at once, and kept off until the normal supply was resumed. This statement was broadcast in all the districts supplied by the Department from ten loud-speaker vans lent by the Ministry of Information; it appeared in the Press and was shown on cinema screens; and inspectors were sent round to give warning.

The Ministry of Fuel and Power was asked to take action, and after consulting the War Office, Major Lloyd George decided that the troops should take over the gas-works. Three hundred soldiers, travelling all night, arrived at the works at 8 o'clock on Friday morning; 200 were put to work at Bradford Road, the others at Rochdale Road, and during the day there were added 47 soldiers skilled in gas production. Manchester firms connected with the Gas Industry also gave help. The Ministry of Labour issued a statement that the Government were determined to see that this essential service to the community was maintained, and the necessary alternative labour was already working. The strike had been condemned by the Trade Union, and there could be no excuse for any worker who failed to realize that it was his duty to return to work at once.

Mr. Cadman stated that the soldiers were helping very willingly, and the co-operation between them and the technicians was good.

When the Strike Committee met on Friday they disagreed as to whether the men should be advised to return to work. Reporters were not admitted to the mass meeting which followed, but the statements made by those who were present justify the description of the proceedings as stormy and rowdy. Some speakers said "Go back," other said "Hold out," and a few men came to blows. Two Union officials were shouted down, and the meeting broke up without a decision having been reached except that it would be continued on Saturday morning. About 250 came to this meeting and the strike was discussed calmly for the first time since it began. Councillor Butters afterwards announced that the strikers had unanimously decided to return to work and the full complement would go back on the afternoon shift at 2 p.m. An undertaking had been given that their wages grievances would be brought before the Regional Joint Council. The management had promised that there would be no victimization.

Mr. Cadman stated that the supply of gas would be resumed on Sunday about 10 a.m., but consumers should use it with the greatest economy. At a number of hospitals permission to make a limited use of gas was given on Saturday night.

Great inconvenience was caused to those who use gas for cooking in households, restaurants, and cafés, or for power in works, and the shortage of coal and coke added to the trouble. Much ingenuity was shown in making arrangements to tide over difficulties. Probably the hospitals were the worst hit. From the beginning to the end the strike has been condemned by public opinion, expressed in the Press or in ordinary conversation.

North British Association of Gas Managers

The Spring Meeting of the North British Association of Gas Managers was held in the Grosvenor Restaurant, Glasgow, on April 14, when the President, Mr. Robert Fife, Kilmarnock, welcomed a large attendance. As an Industry, he said, their most intimate concern on the "home front" was the "battle for fuel." In view of recent instructions issued to their industrial consumers he took the opportunity to address a few words to gas consumers in general. The cut of 25% imposed on industrialists was a serious and essential gesture by the Government. The Ministry of Supply and the Ministry of Fuel and Power had here shown very favourable consideration to domestic consumers of gas, knowing full well that all householders were having their own difficulties in respect of coal allowances. He wished to assure domestic consumers that conscientious efforts were being made by industrial users to obey the recent instruction. He appealed, therefore, to the domestic consumer not to abuse the privilege of the unrestricted use of gas.

Mr. James Jamieson, Edinburgh, President of The Institution of Gas Engineers, conveyed the good wishes of the Institution, which recognized the valuable work of the North British Association.

The President thereafter delivered his Address—see last week's "JOURNAL" and later pages of our issue to-day.

Mr. A. Jamieson, Johnstone, Senior Vice-President, said they had all appreciated Mr. Fife's abilities in a social sense. Now, more than ever, they appreciated his qualities as a gas engineer and administrator. He was particularly interested in Mr. Fife's remarks on integration and coke disposal. There was no doubt that these would be two of their major problems in the post-war years. Regarding coke disposal, he regretted that the President had not more to say on the subject of total gasification. The final solution of the whole problem seemed to lie here. Coke, in his opinion, took a position in the economics of gas manufacture out of all proportion to its value as a fuel. They even found in the method adopted by the Gas Engineering Advisory Board of assessing fuel efficiencies that an extra hundredweight of coke made available for sale per ton of coal used was of more value than an extra 3,000 cu.ft. of gas from the same coal, no consideration being given, it should be noted, as to whether such coke contained 2% or 20% of moisture. He suggested that total gasification must come, otherwise the designation of the Industry should be changed to "the Coke and Gas Industry."

Mr. T. S. Lockhart, Rothesay, Junior Vice-President, seconded the vote of thanks.

The company then adjourned for luncheon, Mr. Fife presiding.

Mr. Kenneth Lindsay, M.P. for Kilmarnock Burghs, proposing "The City and County of Glasgow," congratulated Mr. Fife on his Presidency and on the Address he had given that morning. There were many links between Kilmarnock and Glasgow. In Kilmarnock they looked to Glasgow for higher education, for art, music, the theatre, and more and more Glasgow was becoming a centre for these things.

Replying, the Right Honourable the Lord Provost of Glasgow, Mr. James Welsh, said that in his long municipal career he had never been privileged to be a member of the Gas Committee. Evidently it was considered he had not the technical knowledge or political wisdom necessary. Glasgow Gas Department was interesting from a historical point of view. It was in 1869 that the Corporation took over the Gas Company, and this led to further municipalization. The taking over of gas was an immediate success, and the Gas Department had become a great undertaking.

Proposing "The Gas Industry," Sir Patrick J. Dollan, Chairman of the Scottish Fuel Efficiency Committee, said he had been conferring the previous day with Kilmarnock industrialists regarding fuel economy and was well satisfied with the results. In 1936 Scotland produced 32 million tons of coal; the figure was now 24 million. They produced 8 millions less when their industrial requirements were so much greater. If 24 millions were to do the work of 32 millions, they must use the coal with efficiency and economy. Coal would never be as plentiful in Scotland in the future as in the past. Proceeding, Sir Patrick said the Gas Industry had set an example in economy. Between 1912 and 1937 the Scottish consumption had increased by 75%, yet their coal consumption had increased by only 12%. They had obviously been using coal with great economy and efficiency. Mr. Fife had suggested the setting up of a National Fuel Advisory Council with Regional Boards. He suggested an amendment already approved by his Committee—namely, a Scottish Fuel Board to survey the fields of coal, gas, electricity, oil, and peat. The last-named would be more fully exploited as their coal resources diminished. No coal suitable for gas should be sent to any other industry. He hoped such a Board would be set up in Scotland, and that they would not be merely a Region, subject to Whitehall.

Replying, Mr. James Jamieson, Edinburgh, said that the Gas Industry was now processing about 20 million tons of coal a year, and providing some 1,600 million therms of gas and 9 million tons of coke for sale. These two fuels through their greater efficiency in use were replacing the use of at least 40 and 10 million tons of coal respectively, a net saving in coal annually of 30 million tons. Translated into terms of manpower, this meant that, at a modest estimate, at least 100,000 underground pit workers had been released from uncongenial toil, and corresponding employment had been provided on the surface. In the future, science and industry would become more and more the foundations of national security, and the basic need of all industry was fuel—fuel for power and heat and light. It was premature, indeed it would be imprudent, for him to make any attempt to state the lines of this country's future fuel policy, but faced with a world situation in which cheap fuel was the very foundation of their independent existence, and with a prospect of their native fuel becoming increasingly costly to get, it did seem logical to suggest that they must stop digging out coal as fast as they could, using much of it wastefully and sending as much as possible abroad at cut prices, and that they should instead process all the coal in their own country not only to provide more efficient fuels for home use, but to yield for export commodities whose value was high in proportion to the cost of the fuel used in their manufacture. In the days before the outbreak of war there was ample evidence that the public were beginning to look for greater convenience in the provision of domestic heat by the substitution of gas and electricity for solid fuel, and the Gas Industry was not only in process of being fashioned to meet the demand, but had gone a long way towards meeting the most exacting labour-saving requirements of a modern community.

Mr. A. Jamieson, Johnstone, proposed "The Guests," Provost J. H. Carnie, of Kilmarnock responding, and Mr. David Fulton, Helensburgh, proposed the health of the President, who, in his reply, thanked the Secretary and Council for their assistance.

American Kitchens

Miss Jane Drew, F.R.I.B.A., consulting architect to the B.C.G.A. Domestic Heat Services Committee, has returned from her tour of inspection of kitchen planning and space-heating arrangements in the United States, and her report will provide the Committee with many useful ideas. On the whole she is enthusiastic about the way the Americans handle their domestic comfort problems, but there are some aspects which she does not commend for application in this country. The American idea of "bigness," for instance, would not appeal to the average British housewife, and the craze for modernity, as expressed in streamlining, is open to criticism in that it prompts the American housewife to discard a good and useful appliance for something that is very little better, merely because of fast-changing fashion.

Besides being an eminent architect, Jane Drew is herself a housewife—the mother of twin daughters—and she is therefore well qualified to study the domestic aspect of home design. In her view there has been a tendency to deny to the housewife the labour-saving developments of the factory, but in America she found a completely different approach towards women's lives, and good equipment for making homes pleasant and easy to run was considered of the first importance. American homes are not festooned outside with pipes and plumbing. From outside there is not a pipe to be seen, and inside, in far more cases than in this country, not only can you turn on a tap and get hot water, but you can get it at the desired rate, very quickly filling or emptying the bath or basin as you wish. Plumbing and hot-water systems are built in with the structure as part of the design of the building, and not as a later addition, and this applies in principle to all the services and equipment, heating, kitchen cupboarding, ranges, washing machines, washing-up machines, and so on. This designing of equipment with the house means that it can be designed with the space it is to serve, and that each piece of equipment will fit in with the rest. Thus, for example, the kitchen working surfaces and the cooking range are at one level, and the equipment is planned to fit in with the sequence of operations. The design of the heating apparatus and the thermal insulation of the house are considered together, and in reckoning the cost of heating the Americans consider not only the gas boiler or other heat source, but the flues and ducts built in with it, as well as any special precautions for preventing heat loss in winter.

During her sojourn in America Miss Drew "worked" in one of the most up-to-date kitchens. We quote the work "worked" intentionally, for the description she has given of the routine of operations is as unlike kitchen drudgery as anything we have heard. For washing up she loaded a machine, inserted soap flakes, turned a dial, and waited for the "swooshing" noise of the water to cease as a signal that the job was done. Clothes washing was done in much the same way, with a different dial according to the kind of wash required, and the clothes came out dry enough to iron, and wrinkle-free. For ironing she sat at a roller iron and just passed the things through, finishing any fussy bits with a hand iron afterwards. To prepare the vegetables she used a gadget which shelled peas, scraped potatoes and made everything more pleasant and easier to do, the rubbish passing into an automatic refuse destructor. Gas ovens have electric lights in them, switched on and off automatically with the opening and closing of the door. Gas cookers in general are different from ours. They all have space on the top plate for dishing up, and since most of them can be incorporated in what the Americans call "package kitchens," they have square sides and flush backs, with no projections.

Almost every American home has central heating of some kind, and in each room there is a control which allows the occupier to set the temperature and, to a large extent, control the indoor climate. Hot water in an American town may be delivered in a variety of ways, sometimes through pipes in the streets from a central supply station, and sometimes from a storage heater built into the kitchen, where it is usually placed in what might be difficult cupboard space right in the

corner. Owing to the different plumbing system usual in America, hot water is often delivered under pressure directly from the storage heater to the desired point instead, as in England, of going round the house to each place where it is wanted in turn.

The Americans use about twice as much water as we do, and one of the most delightful ways in which they do it is by the shower; not the sort of shower that means standing in a cold bathroom and using a shower that wets the hair, but a luxurious affair in a warm bathroom with a swivelled shower-head, a non-slip bottom to the bath, and a protective curtain. All these advantages combine to give the American housewife more time and leisure and increase the charm of home life.

In Miss Drew's opinion there is no reason why cost should rule out the adoption of these improvements in Britain's post-war homes. Prefabrication and mass production should be capable of combining to keep the expense within the reach of the lower-income groups. Whether or not the first-hand information which the Domestic Heat Services Committee has obtained as the result of Miss Drew's tour will entail any alterations in the plans for seven different types of post-war kitchen which she prepared before going abroad is not a matter on which we can express any opinion, but it is definite that the Committee intends, as soon as circumstances permit, to hold an exhibition of model kitchens based on Miss Drew's plans, so that the world may know what sort of contribution the Gas Industry proposes to make to post-war housing ideals.

Midland Juniors

There was a large attendance at the Annual General Meeting of the Midland Junior Gas Association held at the Chamber of Commerce, Birmingham, on April 13. In the absence of Mr. G. E. Stevenson (Long Eaton), the President, the chair was taken by Mr. W. N. Smirles (Birmingham).

The Secretary (Mr. Alfred Hill) presented the annual report, in which it was recorded that the Milbourne Medal had been awarded to Mr. J. A. Tomes (Stourbridge) for his Paper on "Some Effects of War on the Economics of Gas Manufacture and Supply." Mr. Milbourne sent a message of regret that he was unable to be present, and the medal bearing his name was formally presented by the Chairman.

Mr. George Smith (Hon. Treasurer) gave a financial statement in which he said the past year was the first full year since the outbreak of war, and the first year in which they had asked for subscriptions since the commencement of hostilities.

The adoption of the report and accounts was proposed by Mr. F. N. Tidball (Cannock), seconded by Mr. S. C. Bentley (Oxford), and carried.

The Chairman announced that the Council had nominated the present Secretary, Mr. Alfred Hill, as Junior Vice-President.

Thanks were expressed to the retiring members of the Council, Mr. H. J. Reynolds (Wolverhampton) and Mr. D. J. Ward (Birmingham), and Mr. E. T. Pickering, *ex officio*. The resolution was proposed by Mr. K. L. Pearce and seconded by Mr. A. W. Attwood.

Mr. Pickering, responding, said he had been a member of the Council for twelve years with only one year's break.

Mr. F. J. Bengough (Birmingham) proposed a vote of thanks to the officers, and spoke particularly of the work of Mr. Hill. Mr. Reynolds, seconding, said Mr. Hill had been Secretary for ten years.

The following officers were appointed for the coming year: *Hon. Secretary*, Mr. A. Hill; *Hon. Treasurer*, Mr. G. W. Smith; *Hon. Auditor*, Mr. E. G. Jeynes; *Members of the Council*, Mr. J. A. Tomes as District Member, and Mr. E. Haden as Birmingham Member.

It was announced that Mr. H. R. Hems, one of the Education Representatives, was now representing the Seniors in a similar capacity. The Council proposed Mr. E. T. Pickering to the position vacated by Mr. Hems. This was agreed, and Mr. W. MacNaughton, Mr. F. L. Atkin, and Mr. F. A. C. Pykett were reappointed Education Representatives.

Mr. H. Platt (Bolton) gave an account of the activities carried out on behalf of the Juniors, and spoke of the co-ordination that had been effected with the Senior bodies.

The new President, Mr. F. J. Bengough, was then inducted to the Chair by Mr. Smirles.

Mr. Bengough proposed a vote of thanks to the retiring President, Mr. Stevenson, and Mr. Pearce seconded.

Mr. Bengough then gave his Presidential Address.

Mr. E. T. Pickering proposed a vote of thanks to Mr. Bengough and Mr. Attwood seconded.

National Gas Council

A Meeting of the Central Executive Board of the National Gas Council was held on April 18, at Gas Industry House. The Chair was taken by Mr. Frank H. Jones (Vice-Chairman).

A report on the general coal position was received.

Dr. Evans, Chairman of the Gas Advisory Committee to the Ministry of Fuel and Power, reported the proceedings at a meeting of the Committee held the previous day. Among the matters discussed at that meeting were (i) Restriction by Order of the Ministry of Fuel and Power on gas consumption by industrial concerns. (ii) Method of approach to domestic consumers using increased quantities of gas. iii) Removal of tar and ammoniacal liquor from Gas-Works.

The Statement in the House of Commons made by the Minister of Fuel and Power on March 28 with regard to the appointment of a Fuel Advisory Council which had been circulated to the members of the Board was welcomed.

It was stated that a report on the evidence on behalf of the National Gas Council given before the Interdepartmental Committee on March 28 had been circulated to the members of the Board, and this report was amplified by Mr. Valon, a member of the deputation which interviewed the Interdepartmental Committee.

Dr. Evans, Chairman of the British Gas Federation, reported that the Federation proposed to set up a Domestic Gas Advisory Centre, with Headquarters in London, as a temporary measure, for the purpose of co-ordinating the work of the various bodies throughout the country that were at present engaged in dealing with questions of the domestic supply of gas. Mr. Masterman had been placed in charge of this Advisory Centre, which it was hoped would later result in each District having a similar organization of its own. It was stated that a letter giving details of the objects and working of the Centre was being sent to the Districts, and the hope was expressed that it would be sympathetically received.

It was agreed that, in view of wartime difficulties, the Annual Meeting should be postponed.

The date of the next meeting of the Board was fixed for May 9, at 2 p.m.

Institution of Chemical Engineers

The Annual Meeting of the Institution of Chemical Engineers was held at the Connaught Rooms, Kingsway, W.C. 2, on April 14, the President, Mr. F. A. Greene, in the Chair. Growth of the Institution is continuous; actually the increase in membership during 1943 was one of the largest yet recorded. At Dec. 31 last membership stood at 1,449—an increase of 127.

At the luncheon which followed the meeting, the principal guest was Colonel J. J. Llewellin, Minister of Food. Referring to the valuable services chemical engineers were rendering to the community, he said that without refrigeration the proper feeding of the nation in peacetime was unthinkable and in wartime it would be impossible. After the war much more should be done in this direction. There should be a more efficient and larger fleet of refrigerated ships, more refrigerated railway wagons, and more refrigerated road lorries.

And why should there not be a refrigerator in every new home? If a vast order could be given for refrigerators in relation to the great housing projects we had in mind, that would help the firms engaged in the industry to meet a large part of their overhead charges, and might give a fillip towards the expansion of their export trade. Chemical engineering had also given us the advantages, in wartime, of dehydration, which had saved a great amount of shipping space. He believed also that for some of these dried products there was a future after the war.

At the afternoon session, Mr. J. G. Bennett, Director of the British Coal Utilization Research Association, delivered the first J. Arthur Reavell Lecture, his subject being "Coal and the Chemical Industry."

Diary

April 28.—B.C.G.A. Domestic Heat Services Committee: Meeting at Gas Industry House, 2.30 p.m.

April 29.—Yorkshire Junior Gas Association: Meeting at the New Wortley Works of the Leeds Gas Department. Paper by C. J. Dougherty.

May 3.—Southern Association of Gas Engineers and Managers (Eastern District): Gas Industry House, 2.30 p.m. Paper by C. B. Frisby on "Industrial Psychology in Practice."

May 4.—North of England Gas Managers' Association: Annual Meeting, County Hotel, Newcastle, 2.15 p.m. Presidential Address by Mr. J. W. Pallister.

May 12.—London and Southern District Junior Gas Association: Annual General Meeting, Gas Industry House, 6.30 p.m. Address by Col. C. M. Croft.

May 15.—London and Counties Coke Association: Finance Committee, 10.45 a.m.; Executive Committee, 11.30 a.m.; Central Committee, 1.30 p.m.

May 17.—Midlands District Gas Salesmen's Circle: "Coming-of-Age" Meeting, Imperial Hotel, Birmingham, 2.30 p.m. Address by Mr. R. J. Rogers.

May 18.—Wales and Monmouthshire Association of Gas Engineers and Managers: Meeting at Pontypridd.

May 28.—Scottish Junior Gas Association (Eastern District): Annual Meeting, Heriot-Watt College, Edinburgh.

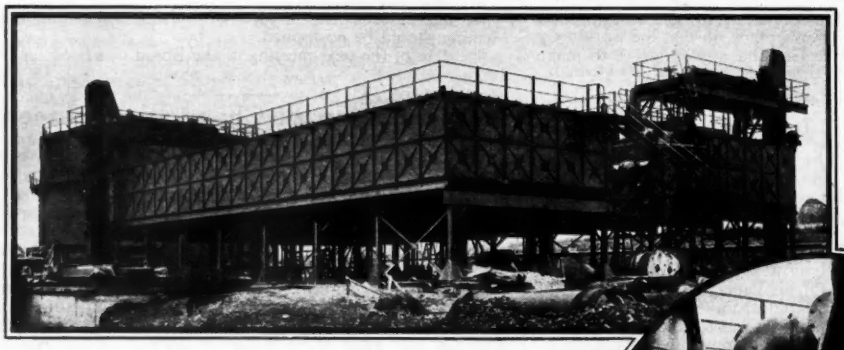
May 31.—Eastern Counties Gas Engineers' and Managers' Association: Spring Meeting, Connaught Rooms, Kingsway, W.C. 2.

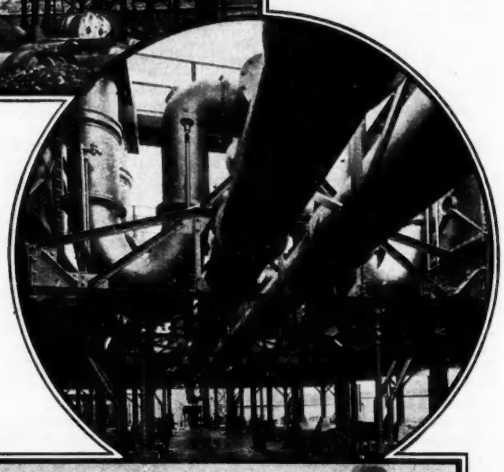
June 13–14.—Institution of Gas Engineers: Annual Meeting, Edinburgh.

At a Meeting of the Callington (Cornwall) Parish Council a letter was read from the Gas Company stating that it was their intention during the summer to overhaul the whole of the lighting equipment so that it would be ready for use at short notice. They felt that they would be able to light at least 75% of the lamps, if not the whole of them, within 48 hours after receiving instructions.

ELEVATED DEEP PURIFIERS

by Dempster OF ELLAND





As specialists in Purifier design, we have given considerable attention to this type of installation, and have built many such sets.

We illustrate a recent contract comprising 8 Boxes, 30′ 0″ × 30′ 0″ × 10′ 0″ deep on Steel Structure, with our Combined Travelling Oxide Plant and Cover Lifting Gear.

Top: General view. (In background, Gas-holder also erected by us.)
Inset: Showing Connections.
Bottom: Overhead view.

These Purifiers designed for a gross capacity of 8,000,000 cu. ft. of gas per day.

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War-Time Experiences in Personnel Control*

By JOHN BATEMAN, Superintendent, Neepsend Gas-Works, Sheffield

IT is a far cry now to those days of peacetime when labour could be obtained for the asking, and when either employer or employee, if dissatisfied, had the remedy in his own hands. In those days we generally employed men as required on a temporary basis, and eventually, if they had proved their worth, they were given the opportunity of a permanent post as vacancies occurred. In this manner throughout the years most works had built up a reliable staff, the acme of achievement for most of them being to obtain a position as retort house stoker, and these jobs were eagerly sought after.

To-day, the inexorable law of supply and demand has meant a complete reversal of the position. Output in the Gas Industry has gone up by 16% since 1938 according to recently published figures, which means a much higher increase in many individual works. Labour input has steadily deteriorated in quantity and quality, and there has been the inevitable loss of men through retirement, as well as young men called to the Forces. Add to all this that manufacturing plant is crying out for renewal and repairs, and the burden placed on the management's shoulders is readily appreciated. But it is to the supervisors and foremen who come in direct contact with the men that my admiration and sympathy go out. These are the people who have to act as a buffer between management and men, and ensure that the orders given are efficiently carried out. Far too little has been said in praise of the war effort of these men who carry out an unenviable task with uncomplaining fortitude. The backbone of every well-run works is the foremen who are responsible for getting the work done and who, all too often, are required to put in many long hours attending to their multifarious duties.

Staffing a New Plant, 1940

The Author had the task of staffing and assisting to start up a complete new gas plant in 1940. The jobs to be filled were such as attendants for gas engines, compressors, boosters, exhausters, pumps, &c., and operators for water gas plant, &c., there being five automatically operated generators in all.

There were no experienced gas-works trained men available, the only source of labour being the heterogeneous collection of builders' labourers on the site who, to say the least, can hardly be called mechanically minded. Prior to the plant being completed, a list of the positions to be filled was drawn up and an unobtrusive watch kept on the men working on the site. In twos and threes men were selected and quietly transferred to the erectors. A few days here soon showed if they had any mechanical aptitude, and those showing promise were kept at this class of work. In this manner a sufficient number of men were obtained to form the nucleus of the staff, and by allowing them to work with the erectors and fitters, they became familiar with the plant which, later, they would operate.

Two ex-hosier mechanics and one of the erectors were engaged to act as shift engineers, and their training was carried out systematically by the Author. Each day a little more was added to their store of knowledge, and they were taught to operate each plant themselves so that they in turn could supervise the shift under their charge. Short concise instructions were drawn up for every job, and the plant was put to work in sections with the aid of these, the shift engineers, and a temporary chemist supervisor.

In the initial stages it meant the Author putting in some 16 to 17 hours daily in order to cover all three shifts. By the end of the first fortnight a few changes in personnel had been necessary, but the majority of the men were settling down and improving daily. By the end of two months a steady routine had developed, until at the end of the first six months the whole plant was a model of efficiency whose personnel control did not occasion any worry to the management, who were thus free to pursue the more elusive technical efficiency.

It should be noted that of the original selection, 80% proved able for the job, and with this solid nucleus it was much easier to fill vacancies as they occurred. This experience is given in order to show that at that time it was still possible to get labour, which by judicious selection and systematic training could be turned into skilled plant operators, while the management, free of labour worries, could devote more time to technical control.

Increased Production *v.* Reduced Labour, 1942

Some two years later the Author faced the task of reorganizing a works of well over 1,000 million per annum capacity, where production was increasing and labour was in short supply and, due to the prolonged illness of his predecessor, and consequent lack of supervision, control of personnel had got rather out of hand. With commendable foresight the engineer had seen that his gas manufacturing plant was up to date and in first-class condition at the outbreak of war, but none could have foreseen the enormous demand for gas as well as the serious labour shortage in the Gas Industry for some three years later.

The method of overcoming the difficulty forms an outstanding example of the adaptation of piece-work rates to gas manufacture, and in this instance proved the solution to a very knotty problem. Each shift in the retort house was two men short of the full complement, and these two wages were equally divided among the remainder of the shift provided the full work was carried out to the superintendent's satisfaction.

Fortunately, the retort house staff were mostly old hands and well seasoned in the retort house atmosphere, and they took the extra work in their stride once the initial stages were overcome. In this way, without extra men and at no extra cost, the full plant was manned and gave entire satisfaction; in fact, during one bad spell this retort house turned out over 10% more than the makers' guarantee figures obtained several years previously.

The next problem was purifying. In no part of the gas manufacturing process can more labour be wasted unnecessarily than in oxide handling. This problem was tackled from three angles:

1. Adoption of piecework rates.
2. Mechanical handling of oxide.
3. Technical control of purification.

The average cost of emptying and filling a purifier was taken over a period, and this sum was offered to the purifying squad to be equally divided between them. After much hesitation they agreed to try it, and soon, where previously it had been difficult to find men for cleaning a box, the problem arose of giving each man his turn. Oxide breaking was tackled in the same way, and one immediate effect was the astonishing reliability of the portable oxide breakers, whereas previously they had been breaking down repeatedly.

However, it was in the mechanical handling of oxide that the greatest saving in labour was made. The installation of an air compressor and piping to the purifiers for pneumatic spades and rippers proved a boon in the tedious occupation of emptying 150 tons of oxide from a box. Two 25 cwt. Lister tipping trucks received the oxide as it was discharged from the overhead boxes, and were used to distribute the oxide evenly on the floor in readiness for breaking with the portable breakers. Portable conveyors were used to collect the revivified oxide ready for the next box, and also for unloading new oxide or loading spent oxide to rail wagons. The whole aim was to reduce the number of times a batch of oxide had to be handled, and when movement was necessary to eliminate wheelbarrows in favour of mechanical methods.

Efficient technical control of purification provides ample material for a Paper on its own and is outside the scope of the present subject. Suffice it to say that the methods adopted included accurate measurement of gas flow through each set of purifiers, control of temperature, there being gas heaters fitted on the outlet of each box, control of oxygen admitted for revivification *in situ*, and the judicious use of live steam. All the necessary records were kept and conditions carefully studied.

The effect of these efforts was to increase the gas purified through each set by some 20%, and to work the oxide up to 50% sulphur content in two foulings. Fewer boxes were cleaned, and that operation now took half the men half the time as compared with previous practice. The sum total at the end of twelve months on this works was an increase in production of 20% compared with the previous year, coupled with a reduction in labour of 15%.

Man-Power Problems, 1944

Taking charge of a large works at this advanced stage in the war is no light matter, and when the Author faced this task some twelve months ago the difficulties were soon apparent. A growing shortage of materials and long delay in getting delivery greatly retards alterations to and maintenance of plant. It is very difficult to provide for every eventuality for 9 to 12 months ahead. Coupled with this, the labour position, particularly with regard to retort house workers, has steadily deteriorated, and the men coming forward are in most cases unsuitable for training for any semi-skilled job, as the following figures taken over the last twelve months will show:

Number of men sent from Labour Exchange	107
,, ,, engaged	39
,, ,, ,, and still employed	24
,, ,, ,, ,, ,, in retort house jobs ...	8

That is to say, of the total men sent from the Labour Exchange during the past twelve months, about 8% were suitable for training as retort house workers.

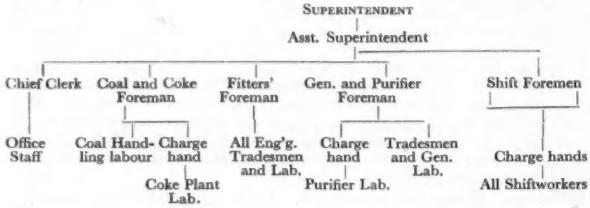
The problem soon resolved itself into one of reorganization of the existing works personnel by endeavouring to remove the square pegs from round holes. Personnel control starts at the top, and it is essential that a works manager and his assistant should be on friendly terms. This does not necessarily mean meeting outside business hours in a social capacity; probably it is better not to do so; but it does mean transacting the daily affairs amid a spirit of friendliness.

In dealing with foremen and charge-hands, it is essential to get under the surface and get to know something of the man's home life and background, so that his mental outlook on his work can be properly

* An Address to the Yorkshire Junior Gas Association, March 25.

appreciated. Care must be taken not to issue orders to men over the foreman's head or, if this is necessary, the foreman should be notified as soon as possible. Nothing saps a foreman's confidence more than to have his superior ignore him by dealing direct with the men.

The next step is to see that proper supervision, without overlapping, is given to every operation, every part of the plant, and every man employed. The system of personnel supervision adopted was as follows:



It will be seen from this diagram that the superintendent and his assistant, while working in close co-operation, have divided out the duties so that personal supervision by one or the other reaches every part of the plant daily.

Each section of the plant was taken in turn, and changes made in personnel and working conditions as proved necessary. Every effort was made to see that each man was placed in the job he was most suited for and left there. For every job, no matter how unimportant it may seem, the worker must have clear instructions and proper supervision. Every man has ready access to the Superintendent and all grievances are investigated; no matter how trivial they may seem to the management they are important to the man and, if ignored, the molehill soon becomes a mountain.

The innovation of a works canteen has proved a boon in providing hot mid-day meals and hot beverages. The average daily attendance for dinners is about 33% of the total men employed, and bearing in mind the number of shift-workers this is quite a good figure. In addition, some 1,500 mugs of tea or coffee are consumed daily. The canteen is run on a non-profit-making basis by a Canteen Committee comprising representatives of the employees and the management. In a similar manner, a representative Clothing Committee deals with the issue of clothing coupons.

A steady improvement in relations with the men has resulted, and the reduction in absenteeism and illness over the past twelve months has been most gratifying, as the following figures will show:

Average Man-Hours lost per Week.

Cause.	Feb., 1943.	Feb., 1944.
Accidents	137	94
Illness	1,110	717
Absenteeism	925	143

Accidents can happen in the best run works, but every reasonable precaution is taken to prevent them, not the least being education of the worker, and in this respect the posters issued by the Ministry of Labour are very helpful.

There can be no doubt that the reduction of illness can be attributed in part to the provision of a canteen supplying hot food, especially in cold weather. Absenteeism is now less than 1% of the total men employed, and under present conditions can be regarded as satisfactory.

Apart from the canteen staff no women are employed, but it is worthy of mention that 12% of the employees are over 65 years of age, and most of them having lengthy service can testify that life on a gas-works has no ill effect on a man's health. The contrary would appear to be the case.

While maintaining production up to previous standards, it has been possible, with the co-operation of all concerned, to make a saving in labour of over 10% as compared with the same period last year.

Conclusions

As a result of his experiences the Author has come to the following conclusions:

1. For the successful management of men the following qualities are essential: (*a*) Knowledge, (*b*) leadership, (*c*) loyalty.

Knowledge implies knowing your job in order to issue proper instructions and earn the confidence and respect of your men.

Leadership means setting a good example to your men, and no matter the difficulties, always conveying the impression of being on top of the job. British workers may be led where they cannot be driven.

Loyalty to both employers and men. It must be remembered that you are the representative of your employers, and it is your duty to see the work done efficiently. At the same time, loyalty to your men implies giving them what is best known as a square deal.

2. Almost all grievances are connected with wages, and while many and varied complaints may be brought forward, wages remain the chief point of difference between employer and employee. The Author is against flat time rates for all classes of labour, as in this system the speedy worker soon reduces himself to the speed of the slowest man, and this cannot make for efficient production. Rather does he favour payment by results—*i.e.*, piecework, or payment according to the job being done. In this way there is always an incentive for the worker to try to improve himself by qualifying for a higher paid job.

3. Company employees work harder than their counterpart in Corporation service, and this refers not only to manual workers. This is not an attempt to decry the ability or efficiency of Corporation staff or plant, but, having experience of both, it is the Author's considered opinion. A study of the Technical Press shows that Companies offer higher salaries than Corporations, and there may be some connection here as well as in the fact that a manager in Corporation service is subject to the control of a Committee, which in many cases contains representatives of the workers' trade unions, thus creating the anomalous position of the worker having indirect control of his employer.

4. The National Service Officers and Local Appeal Boards have dealt very fair and justly with the extremely difficult problem of dissatisfied workers, and if a criticism may be necessary at all, it is that the Manpower Board have been slow to appreciate the real importance of the Gas Industry, and the fact that the comparatively small technical staff would be far better employed in concentrating on technical efficiency, instead of devoting so much time to training and supervising personnel which in many cases is quite unsuited for the job on hand.

5. Finally, for the future the Author is of the opinion that the Gas Industry must concentrate on efficiency, and so provide a stimulant to industry in the form of a reliable and economical fuel. It is not our duty to create unproductive work for the local unemployed when that time comes, but, by encouraging local industry, to assist to create employment. We want more skilled and semi-skilled workers rather than the general labouring class in future.

When it is considered that most men seek security of employment, and that the Gas Industry is a "sheltered industry," there should be no difficulty in building up the right type of staff which, with proper incentive, will assist to give us that efficiency which is desired. In this connexion the Author is all in favour of improved working conditions and the provision of reasonable amenities, but we must not lose sight of the fact that the primary purpose a man is employed for is to *work*. A fair day's work in return for a fair wage.

North British Association of Gas Managers

Presidential Address*

of

R. FIFE,

KILMARNOCK

(*Concluded from p. 504*)

Failing adequate outlets, the Industry, at the appropriate time, could easily take a survey or census of its gas and coke consumers' requirements with a view to balancing production and consumption. I suggest that in the future more consideration be given to the control of coke output.

While we claim flexibility in our vertical retort processes, the gas-coke ratio can be modified only by altering declared calorific values. The second stage process of water-gas manufacture is a useful means of absorbing surplus coke, but this method is not available to every undertaking, and carburetting with oil appears likely to be costly.

The husbanding of the nation's coal, consistent with the lowest possible cost of gas production, must claim our first attention. Instead, therefore, of using that additional coal to produce unwanted coke which, at least from inland sources, had often to be sold for shipment at unremunerative prices, a better balance of products might be obtained, with advantage to the Industry, by gasifying more coke and lowering calorific values. Suggestions from responsible quarters have been made of 400 or 425 B.Th.U. gas being the ultimate standard for Scotland, either quality of gas being suitable for industrial as well as domestic purposes.

The problem of balancing our two major products is one for at least regional consideration, and, it must be admitted, this involves many variable factors. In his Paper to The Institution of Gas Engineers last June, Mr. J. E. Davis recorded very fully all the facts associated with the technique and economies of producing low quality gas. I would recommend a study of Mr. Davis's Paper in conjunction with the findings of the Committee of Inquiry on Gas Quality (Institution Communication 249), printed in full in the Technical Press in October, 1942.

It is the function of the Coke Association, to which I am about to refer, to resolve the problems of coke disposal, but it is our duty primarily to regulate output.

New Organizations in Scotland

I shall now refer briefly to the importance of two new organizations which came into being in Scotland last year, and I would recommend all gas undertakings to support them.

The competitive position of gas will be greatly improved if revenues

* Presented at the Spring Meeting in Glasgow on April 14.

from coke can be maintained at reasonable levels, but it is doubtful if coke prices can be maintained and steady markets secured by the haphazard method of marketing that has prevailed in the past. Hence the need for a Scottish Coke Association.

Nine such Associations have now been formed covering all areas in the United Kingdom where coke is produced or sold in quantity, and they come together as a national body through their representation on the Central Committee of the National Federation of Gas Coke Associations. That body in turn is a member of the Solid Smokeless Fuel Federation, so that all the smokeless fuel industries are now working together with the object of building up stable and remunerative markets for their products.

This object can be achieved only upon certain conditions—namely:

(1) That the fuel shall be of a quality acceptable to the consumer and at a price which can be regarded as reasonable, having regard not only to the price of other fuels, but to the thermal value and cleanliness of the coke offered for sale.

(2) That appliances of correct design and finish for the best use of coke shall be available at reasonable prices.

(3) That adequate sales and technical services shall be provided both to give advice to consumers and to explore and develop new markets.

(4) That a measure of price control shall be operated in the interests of consumers, producers, and distributors alike.

It is the function of the Coke Association to see that these conditions are fulfilled. Much has already been done in the framing of price schedules and margins to distributors, in the investigation of the properties and performance of coke of varying qualities and sizes, in the development of properly designed coke-burning apparatus, and, generally, in the building up of an organization for mutual help between producers and for the service of consumers. Much remains to be done, and the fullest benefits of such an organization can be realized only with the active co-operation of every coke producer.

The considerable increase in recent years in the consumption of gas for industrial purposes is most encouraging to our Industry. In some districts the increases have been phenomenal, and, while much of the demand has been consequent upon the need for munitions, I believe that we shall retain a considerable portion of this useful load.

In order to develop the excellent opportunities now available in the industrial field, wide support should be given to the Scottish Industrial Gas Development Centre set up in Glasgow last year. The Gas Industry in Scotland is indebted in no small measure to the Glasgow Corporation Gas Department for the assistance given in setting in motion the machinery of what must now be regarded as an essential organization. Glasgow has undertaken the provision of suitable premises for the Centre, and also a competent staff experienced in the industrial applications of town gas. Appliances, both industrial and domestic, are on display, and the necessary apparatus is gradually being accumulated for experimental and research work relating to the use of gaseous fuel in industrial heat-treatment processes. The staff carries out tests and collates and furnishes technical information for the benefit of the member undertakings.

The establishment of this Industrial Gas Centre automatically brings information from similar Centres in England and Wales. The pooling of this information is one of the vital factors contributing to the successful functioning of the ten widely dispersed Centres. Facts pertaining to design, operation, gas consumption, and efficiencies of appliances are tabulated in great detail. It is fair to say that research on the industrial applications of town gas is no new venture in Scotland. For some years the larger undertakings, notably Glasgow, have been successfully extending their activities into the industrial field, and a number of specialized industrial appliances of original design have been produced in Scotland.

Eighty-two undertakings responsible for 76.9% of the gas output in Scotland are already giving their support to this new organization. As the low cost of membership is quite out of proportion to the advantages obtainable, I would suggest that the question of membership should receive the serious consideration of all undertakings still outside the Scheme.

At this point it gives me great personal pleasure to speak of Mr. James Jamieson, Engineer and General Manager of the City of Edinburgh Gas Department, and one of our Association's Past-Presidents. As a gas engineer Mr. Jamieson stands in the front rank of his time, not because he aspired to high office—for he is a modest man—but because of his wide knowledge and his untiring and invaluable efforts in furthering the cause of our Industry. Endowed with a capacity for hard work, coupled with a keen and loyal regard for the affairs of the Industry, he has borne a big share of our administrative burdens in Scotland. Yet in the midst of a full and busy life Mr. Jamieson can always spare the time to give able advice and help to any who seek his assistance. It is 32 years since a Scottish gas engineer serving in his own country occupied the Presidential Chair of The Institution of Gas Engineers. That this honour, after so many years, has fallen to Mr. Jamieson, is a tribute to his outstanding qualities. It is with great pleasure, therefore, that I extend to him, on behalf of the North British Association of Gas Managers, our sincere congratulations and very best wishes.

The Kilmarnock Gas Undertaking

Gas was first introduced into Kilmarnock in 1822, only a few years after its inauguration in London and Glasgow. The Kilmarnock Gas Light Company administered the affairs of the Gas Undertaking until 1872, when it was purchased by the Town Council, at which date the annual output of gas had reached 30 million cu.ft.

The works were operated on the original site until 1902, when it became necessary through lack of space to effect a change. The gas output had then reached 140 million cu.ft. per annum. Ground covering 16¼ acres was purchased in a more suitable quarter of the town, and full advantage was taken of this roomy site to plan a well conceived layout of the new works. Allowances were made for the extension of all the individual units of plant, and even to-day, after 40 years, this foresight on the part of my predecessors continues to prove eminently advantageous.

The growth and development of the Undertaking is exhibited in the accompanying graphs 1 (*a*) and 1 (*b*).

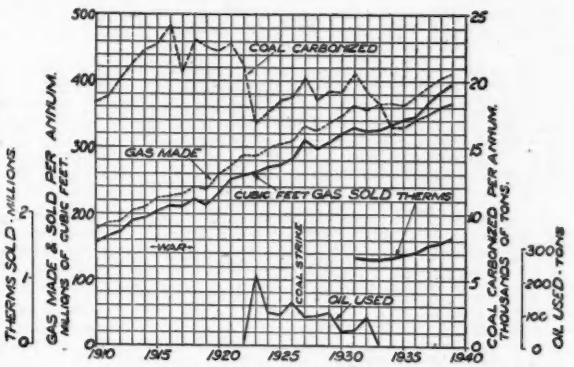


FIG. 1 (*a*).—*Coal Carbonized in Relation to Gas Made and Sold (Kilmarnock).*

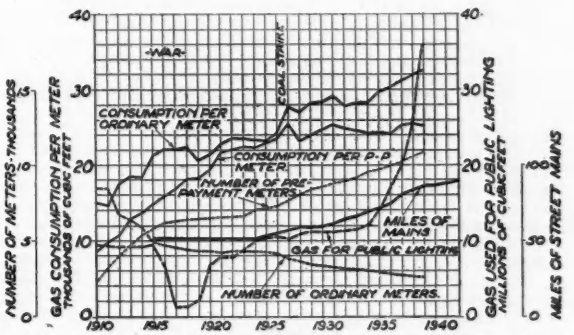


FIG. 1 (*b*).—*Development in Sales of Gas, &c. at Kilmarnock.*

The retort bench of Glover-West continuous vertical retorts is housed in the spacious and robust original horizontal retort house, and comprises twenty-four 50-in. silica retorts, 25 ft. long with steaming chambers. The bench has a nominal capacity of approximately 2¼ million cu.ft. per day, and is complete with mechanical coal and coke handling units.

The producers are of the latest step-grate type fitted with steam-air blowers. Control in the operation of each producer is facilitated by a set of gauges giving the pressure of steam, the temperature of steam-air mixture, and the pressures of producer gas in the uptake flues. I may refer you to a Paper entitled "Breeze-Burning Producers" by a member of my staff in 1934 and published in the Technical Press in December of that year.

Producers of this type simplify the control of the heating of the bench, and clinker formation in the producers can be kept to a minimum by regulation of the steam-air mixture, since both the steam and the air are separately controlled.

The breeze used in the producers is practically dust free, the dust up to ¼ in. being roughly screened out, and the breeze is sized from ¼ in. to 1 in. or at times to 1¼ in. Producer fuel of high ash content created some trouble by causing formations of caked ash within the producers, giving rise to "channelling," which allowed some of the primary air to pass through the fuel bed. A proportion of the producer gas was thus consumed in the uptake flues, which became overheated, with a corresponding loss of heat in the setting. This problem has been completely solved by a change in the method of producer cleaning.

It is found that the producers can be more thoroughly cleaned by inserting false bars daily on top of the third plate of the step grate and removing the ash from below. When the false bars are withdrawn the drop which then occurs in the fuel bed disturbs it sufficiently to dislodge any caked ash adhering to the producer walls. This method has the twofold advantage of removing from the producers

an almost coke-free ash and of obviating the short-circuiting of the primary air.

Coke from the retorts is conveyed by mechanical means to a West's reciprocating coke grader. The substantial screens are of cast iron and some are still in use after 11 years' service. The coke hoppers are divided to take the following four grades: (*a*) Dust, (*b*) ¼ in. to ¾ in., (*c*) ¾in. to 1¼ in. nuts, and (*d*) large coke, and they are conveniently arranged to allow for the direct filling of either road or railway wagons.

Throughout, the coke is handled with a minimum of breakage, and a definite consistency in sizing is maintained by this method of screening. When the coke-grading plant was erected, circumstances allowed of the installation being placed under cover. The exclusion of varying weather conditions has greatly assisted in the maintenance of high screening efficiency and in the preservation of the plant.

The waste-heat boiler is a Spencer-Bonecourt, having a steaming capacity of 9,000 lb. per hour, and operated by induced draught. It is equipped with "Thermofeed" regulator and high and low water alarms.

It costs as much in fuel to produce one therm of steam as it does to produce one therm of gas, so that even though fuel is recovered from the waste products of combustion leaving the retort bench, care in the operation and maintenance of the boiler must not be neglected. I have found that the little extra trouble required to trace and point up the smallest brickwork cracks is handsomely repaid in improved results. The water evaporated per lb. of producer fuel from and at 212°F. has averaged 4.2 lb. over the past winter.

Some time ago the accumulation of scale on the inlet tube plate of the waste heat boiler and for 9 ft. along the tubes caused some concern, and its continuance would have resulted in leakages at the junction of the tubes and tube plate. Manual removal of the scale being impossible, it was decided to apply a chemical de-scaling process known as the "Clensol" method. This proved most successful, and a brief reference to the treatment might provide a useful line of thought to other engineers. The process consists of attacking the scale with an inhibited acid solution of pre-determined strength, the composition of the scale having previously been determined by analysis. The treatment, which was conducted in strict accordance with the suppliers' instructions, covered a period of 72 hours, when the scale was found to be completely removed. The process, which demands only a minimum of dismantling, searches out all the inaccessible places. While the costs of materials are relatively high, the labour costs are low, and the plant is out of commission for only a short period.

The success of the de-scaling was amply confirmed by an increase in the absorption of heat, which reduced the boiler outlet temperature by 40°C. (from 230°C. to 190°C.).

In considering the installation of new water-cooled condensers a few years ago, it was decided to erect two 1¼ million cu.ft. per day units instead of one 2½ million set. Condensers of this type should be in duplicate to allow for cleaning or replacement of tubes. I mention this because I have known of undertakings being seriously inconvenienced when depending on a single set of water-cooled condensers.

Provision has been made for the storage of fully 2,000 tons of coal under cover. The arrangement of the original bunker with a floor area of nearly 11,000 sq. ft. made it difficult to replenish stocks in sequence of age. The problem was solved by erecting three brick walls which divide the bunker into four bays, each holding 500 tons of coal. Each lot may be used and renewed separately and in sequence. It is possible in this way to obviate the disadvantage of discharging fresh coal among old stocks.

The magnificent contribution to the war effort made by the Gas Industry is a story which in the fulness of time will doubtless be placed on record. On duties associated with the Gas Engineering Advisory Board I have been privileged to visit many gas-works, and I have found time and again major difficulties being surmounted by sheer determination and hard work. The call for increased output of gas has been answered notwithstanding the general depreciation in quality of coal and the serious depletion of regular staffs. Under conditions of exceptional strain employees have displayed a full measure of loyalty and co-operation in the discharge of their duties. We might claim, with becoming modesty, that the Scottish Gas Industry has admirably lived up to the excellent motto of our parent Institution—"By diligence we serve."

At the Ordinary General Meeting of the Montevideo Gas & Dry Dock Company, Ltd., to be held on May 16, the Directors will recommend payment of a final dividend of 3% free of income tax, 2% of which payable on May 17, and 1% on Dec. 1, making with the interim dividend of 1% paid on Dec. 1, 1943, 4% free of income tax for the year ended Dec. 31, 1943.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

Heat Treatment of Metals*

By M. H. CHANTRY

I AM writing from the point of view of one chiefly concerned with heavier sections, but the question of temperature distribution arises with all sizes. I would tentatively suggest that many people handling small sections are taking an unnecessarily long time over their job, while many large bars are rushed through too quickly. Somewhere in the region of 4-in. dia. the importance of time *versus* dimension becomes pressing. The empirical method of allowing a certain soaking time per inch of thickness is not accurate enough for close tolerance working. It may be said that irregular results are promoted by—

(*a*) Rapid heating—*i.e.*, too great a difference between temperature of furnace and that of metal; (*b*) decrease in conductivity of material; (*c*) increase in size of material pieces.

Irregular and severe temperature gradients are the source of stress differences being set up in the specimen under treatment. It is usual to state merely that they are of a high order, which surely is only begging the question. A complete treatment of the subject would itself made a whole Paper, as so many variables, dimensions, phase inversions, conductivities, expansions and gradients are involved. Suffice it that in a 5-in. diam. steel bar, water quenched, at a point near the end of cooling, the stress at the surface layer may be of the order of 70 tons per sq.in., and in materials of high rigidity may be even higher. On heating, when the rate of temperature change is not so high as this the stresses are not so great, but it is quite possible to ruin valuable material by injudicious heating. Ingots and cast structures come to mind as being particularly susceptible to this risk. It is no pleasant thing to be confronted after heat treatment by a 12-in. ingot of 10% tungsten die-steel cracked from end to end, fit only for remelting. The same risk applies also to refractories in furnace walls, particularly in heat treatment furnaces and firebox crowns with solid-fuel firing.

When a heat treatment furnace is to be erected, it is taken for granted that the first essential in its design is that it should give uniformity over its working area, and that it should be capable of adjustment in this respect to an extent unknown in almost any other furnace plant. After that, economic questions such as fuel, loading, and output arise. In all heat treatment processes, the highest manufacturing cost is that of labour. Even where equipment is lavishly provided to reduce this, it seems doubtful whether capital charges do not outweigh the saving. It is therefore necessary to design plant which will be as well adapted for handling the work in prospect as possible. For example, a furnace with a bogie hearth is very useful for most annealing and normalizing work. It is not easy to use solid-fuel firing with this type of furnace owing to the rather extravagant call for floor space. The course often taken is to use the time-honoured metal bogie running on cast-iron or chrome-steel balls on a solid hearth. This involves increased maintenance charges, which are accepted on the grounds that they are not disproportionate to the output obtained, which is not always the case with alternative solutions. Another drawback to elaborate and costly installations is that there is a natural reluctance to make structural changes of a radical nature when the type of work to be treated changes, as it assuredly does from time to time.

Fuel Costs

The following figures relate to a plant which consists of three gas-fired furnaces taking 500 B.Th.U. town gas at mains pressure, and one coal-fired furnace on which hand-firing has been replaced by stoker-firing. The figures are from the 1943 returns and are based on that year's costs. They are averaged over 4,500 tons of softening, stress relieving, and similar work, and include treatments from 450° to 500°C., but mostly 650°C. and 800°C. work. The treatment cycles varied from a few hours to four days:

	Gas (500 B.Th.U./cu.ft.).	Coal (14,000 B.Th.U./lb.).
Cost pence per useful therm ...	21.46	10.7

It will be seen that coal-firing offers a decided advantage in fuel cost. In ease of manipulation there is little to choose, and in capital cost the gas has the advantage by a large margin. Comparisons of maintenance costs would be misleading, as the coal-fired furnace was put down for hand-firing and not designed for stoker-firing. The design of the gas-fired furnace was simpler than the coal-fired one, which maintains a uniform temperature over 18 ft. of working length. This type of plant was at one time almost the standard type annealing furnace used in Sheffield, and although it is now being outdated, there are still many similar ones doing good work.

Application of Underfeed Stokers to Annealing Furnaces

For furnaces of this kind the underfeed stoker seems admirably adapted. In this one case the thermal efficiency of the furnace was increased greatly by its installation; and over one period, for certain work, by over 100%. Unfortunately, I am told, other experience has not been so happy. This is probably due to the neglect of necessary alterations to firebox capacity, and possibly also to the mistaken

* From a Paper at a Symposium arranged by the Institute of Fuel and the British Coal Utilization Research Association, March 28.

desire to drive at all times a very powerful piece of plant to the limit of its capacity.

An aspect of the use of mechanical firing, which is greatly appreciated by the user and which may not have received emphasis, is the control offered over the air supply. Air, although free, is as much a fuel as is coal and is preferably controlled by an efficient fan. The chimney, invented, presumably, by Tubal Cain, of blessed memory, is an astonishingly nasty, unwieldy, and costly piece of apparatus. Unless it is disproportionately large for the furnace it serves, the fireman has not the control of his fire which is vital in heat treatment work. It is not satisfactory to submit to limitations imposed by atmospheric conditions. The provision of forced, or, better still, balanced draught relieves the chimney of the work of adequately providing air for combustion, and of excess air when it is least required. In our case, the chimney is used solely as a handy control for end-to-end variations of furnace temperatures, and for the provision of secondary air. It is astonishing how much more effectively main damper alterations control and balance in these circumstances.

One of the attractions of the underfeed stoker is its versatility. An installation can be used as a simple burner, in which case very high temperatures can be attained, as high probably as with gas pre-heated in a regenerator. At the other extreme it can be used as a gas producer, when, being self contained, none of the sensible heat in the gas is lost. It is not, however, easy to obtain a true gas producer performance, and when this is not attained, a firebox full of coked fuel results, which is annoying and troublesome to burn out. Such efforts are made in an attempt to get a hazy reducing atmosphere in the working chamber. This may be done quite readily, but when this type of atmosphere exists, gas velocities are, as a rule, low. And as the rate of heat transfer to material depends, among other things, upon this and varies as a power of the velocity, heating is slowed down. It may be that forced convection and recirculation, so successfully applied to electric furnace practice, will be developed, but I have not heard of any such installation using solid-fuel firing. It would be of great interest to the heat treater for low temperature work, his most difficult operation. The object of working with reducing atmospheres is to avoid chemical reactions in the surface of the load, and, in the case of steel, decarburization and scaling. These are ever-present bogies, but are of less importance on semi-finished bar stock than formerly. In the first place, the present trend is towards lower temperature treatments, in which the reactions proceed fairly slowly; in the second, modern opinion tends to regard a finishing operation as necessary, in which surface conditions are looked after in conjunction with either, or both, straightening and dimensional rectification. The tendency will probably be to increase this emphasis upon a finishing process, but it will remain prudent in any preliminary stage to leave as little as possible to be looked after in subsequent work.

While discussing gas velocities, the question arises as to fly ash. With coal, the problem is slight or absent; with coke, however, it is serious. Increase in the rate of gas flow would probably minimize it, but the increase would have to be so great as to affect other desirable features of working.

An attempt was made to introduce water into the stoker fuel with a view to the generation of water gas. It was hoped to cool down the firebox and to produce a greater temperature further along the furnace. The experiment was not successful. Amounts were difficult to assess, and as hydrogen and water vapour are dangerous substances to have about hot steel (decarburization), the tests were postponed and have not since been continued.

An important advantage possessed by solid-fuel over gaseous firing is in the initial stages of cooling. With some materials it is desirable to cool through a phase change slowly, in order to allow metallographic phenomena to take place. It is, further, often desirable to heat to as little above these ranges as possible. The expression of a cooling body may be put—

$$T = f(t\text{–}x)$$

where T is temperature, t, time, and x, a complex expression which varies in value with the furnace conditions. It will be seen that if left unchecked, cooling will in all cases take place more rapidly at first than later, which may prejudice the results wished for. If retarded cooling is to be obtained with gaseous firing, the gradual cutting off of the supply is somewhat tricky to arrange. It is always easier to accelerate than to retard cooling. With solid fuel, all that is usually necessary is to leave a fair amount of fire in the box and to let a gentle current of air run through it. By the time it is completely consumed, the dangerous range is normally passed.

Furnace Refractories

No furnace can be better than its refractories, and no consideration of improved methods of heat production should overlook the materials upon which its efficient use depends. The underfeed stoker makes severe demands on brickwork, and it must be that cases of dissatisfaction have arisen which could have been traced to failure to recognize this. Particularly do these factors arise when a stoker is put into an existing firebox. In heat treatment the cycle of operations almost always involves heating and cooling at comparatively rapid rates. Owing to thermal-dimensional phenomena, to say nothing of the quartz inversions, such treatment of brickwork is unkind, and common firebrick will not stand the strain. Our own experience with the coal-fired furnace referred to above may perhaps be noted.

	S. Yorks brick.	Best Scotch brick.
Hand-fired	3 weeks	2 years
Stoker-fired	—	5 months

These periods are those in which a shut down for serious repairs became necessary. The repairs are not in themselves expensive, but the loss of output and standing charges are great. When a single stoker is applied to a furnace, in order to obtain uniformity of heating, a fairly extensive flue system is involved, and this has a large heat storage capacity. The result is that several days may elapse between the stoppage and the entry of bricklayers. On the other hand, this system of flues, by reason of the extensive hot surface exposed to the reacting gases, offers advantages over the method of firing using several stokers. To me, this multiplication of fireboxes is expensive and, on moderate-sized furnaces, unnecessary, and almost a confession of failure on the part of the designer. It has the advantage of zoning the furnace, but cannot uniformity be obtained better by other means?

In our own case, an immediate improvement was noted when the Scotch firebricks were replaced at the danger points by a Welsh product containing 28% SiO_2 and 65% Al_2O_3, compared with the 57% SiO_2 and 37% Al_2O_3 previously used. The cost of the brick was multiplied by seven, but the comparatively small number needed made this a secondary consideration. It was found that the service time was about doubled and on balance a gain was recorded. Both slagging and spalling were much reduced. It may be mentioned that the makers claim a refractoriness under load of 50 lb. per sq.in. for the Scotch brick at 1,530°C., and for the Welsh at 1,660°C.

It must be accepted that not until all furnace heat losses are satisfied can any useful work be done. Perhaps this statement is a little too sweeping, but there are certainly important sources of heat loss to be minimized. One of them is the radiation from furnace walls coupled with the heat required for the thermal balance in the wall itself. Until comparatively recently, insulating bricks had to be built as a non-stressed shell round the furnace to arrest outgoing B.Th.U. With the advent of expanded clay insulators this has been altered. This form of insulation can be made to carry loads and be brought right up to the hot face of the chamber, subject to certain limitations of temperature, flame and chemical erosion, and abrasion, &c. Walls can be built with almost any desired characteristic, and the following table, calculated from makers' data, shows what may be expected:

Thickness. F.B.	Thickness. in.	Hot face. °C.	Cold face. °C.	Radiation. B.Th.U./hr. sq.ft.	Heat storage. B.Th.U./sq.ft. above 0°C.
18	—	900	140	700	37,750
9	4½	900	105	400	31,337
4½	9	900	87	300	22,098
4½	13½	900	80	275	24,627
—	13½	900	90	320	10,390

Saturation conditions have been assumed throughout, although the non-equilibrium state of the load applies equally to the walls, and actual service figures will be somewhat less than those obtained on this assumption.

This clay insulator is useless for arches when used alone, owing to spalling troubles, but may be used for the purpose over a minimum thickness of firebrick. For plain walling, spalling is almost non-existent.

Furnace Efficiencies

The assessment of furnace efficiency is not altogether a straightforward operation. The usual method of taking the fuel consumption per unit of output will do for some purposes, but only where the type of work performed remains substantially constant. In such cases the method affords a useful week-by-week record of performance, and no doubt pleases a costing department. It is beyond the resources of many plants to get out a complete thermal balance-sheet, and even when this is done, it is something of an event, undertaken rather to obtain specific information for design purposes.

Probably the fairest way in which to estimate the performance of a heat-treating furnace is to compare the heat input with the heat content of the load at the required temperature. The latter may be estimated from published data for similar material, or calorimetrically determined for the actual work.

The ratio $\frac{\text{B.Th.U. (work)}}{\text{B.Th.U. (fuel)}}$ is then expressed as a percentage.

Hence, the conception of the useful therm. In jobbing practice, where the same furnace is expected to and does give satisfactory results on work varying from 12-in. ingots, *via* large and small billets, 120-in. by 54-in. plates, and so on down to small sizes of bars, a thermal efficiency of 25% may be regarded as satisfactory. I have never heard of 33% being reached in such a batch furnace, and 29% is our best performance. Much depends on how the load can be packed into the available space. In respect of efficiency, *per se*, the gas-fired furnace scores over the solid-fuel job. Even with stoker-firing, our best result has been under 20%, and averages less than 15%. But with hand-firing, it is not possible to maintain a higher efficiency than 5 to 7½%. This lower result with solid fuel is explained in this instance by the fact that the furnace under view is an obsolete design, which, in common with all solid fuel plant, has a greater surface radiating area than an equivalent gas-fired furnace.